DESIGN AND IMPLEMENTATION OF A PROTECTIVE GEAR FOR WORKERS

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CERTIFICATE OF APPROVAL

The project entitled as "**Design and Implementation of a Protective Gear for Workers"** submitted by **Md. Belal Hossain Mahmud**, bearing Matric ID. **ET171022, Md. Bajlur Rashid Sakib,** bearing Matric ID. **ET171041** and **Karim Ul Hasan Bhuiyan,** bearing Matric ID. **ET163032** of session **Spring 2021**, to the Department of Electrical and Electronic Engineering, International Islamic University Chittagong, has been accepted as satisfactory in partial fulfillment of the requirements for the degree of Bachelor of Science in Engineering and approved for the examination held on **24th December, 2021**.

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DECLARATION

It is hereby declared that this work has been done by us and no portion of the work contained in this thesis/project has been submitted elsewhere for the award of any degree or diploma.

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Md. Belal Hossain Mahmud

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Md. Bajlur Rashid Sakib

_____

Karim Ul Hasan Bhuiyan

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ABSTRACT

Since industrial revolution in the 18th century new natural resources had been explored as well as working area for human has been expanded. People have to work on unfavourable and hostile conditions as well as in unhealthy environment. There are chances of many risks starting from long term health issues to sudden death in all of those working areas. There had been many death reported last three centuries in those places. Recently many companies developed some gears for workers. Unfortunately the safety is limited to only precautionary level. So, we aimed at developing a protective gear that reduces the risk of working environment as well as to ensure a safe working place for human being. With the help of small and effective technology and in small cost we tried to develop a project using different apparatus such as gas sensor, humidity and temperature sensor, ultrasonic sensor, heart rate sensor, Arduino, GSM module etc. The gear does not only eliminate the danger by alerting the user measuring different data such as amount of humidity, presence of toxic gas etc but also ensure a safe working environment for people by constant monitoring and sending those data to further analyze through a wireless system. Continuous monitoring is provided in our protective system which was the main limitations of previous works. We used the technologies which are available and cheap which not only makes this gear more effective than other typical protective gear but also makes it economical.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

We live in an age of science and technology. Everyday science is inventing different and new ways to utilize resources those are available to us. So to carry out scientific experiments, people need to work on many unfavourable conditions. Though necessary safety steps were adopted but in most cases they are expensive and limited to precautionary level as well as are not assembled together in one place. For example in mine field before starting of any operation the presence of toxic gases are checked and humidity level are also checked. Labors are provided with necessary protective gears but there is no automatic system to alert labors [1] . So we try to develop a system that assemble all safety elements in one place to automatically alert user in adverse situations.

1.2 Background

With the expansion of working areas, people started working in risky situations and places. In those places environment changes suddenly which often leads to an accident and sometimes bring huge disaster. According to Wikipedia in the last three centuries there were more than 50 accidents occurred in different mind fields of the world [2] .

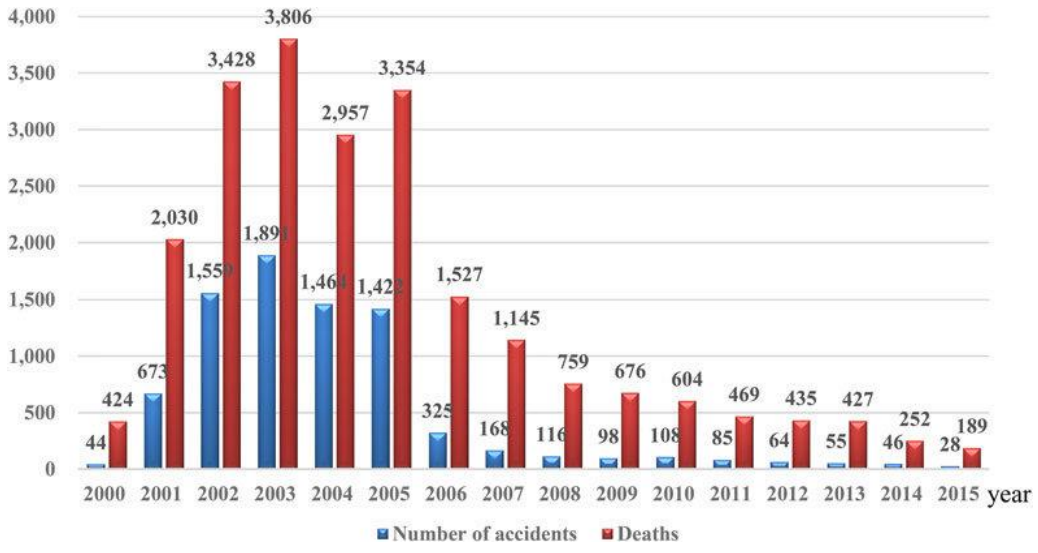

Fig. 1.2.1 : Accidents in the recent year and number of death [3] .

There were more than 500 death reported in those accidents [4] . From another survey, we see the death rate in those accidents which is more than one fifth percents (**Fig. 1.2.1**). So to provide necessary protection for workers many protective gear wear developed. But unfortunately they are not completely suitable. Because the main problem in hostile environment is the sudden change of environment. And in the typical gear there is no automatic protection or alert system. **Fig. 1.2.2** shows a graphical representation of the type of accident occurred in 2015.

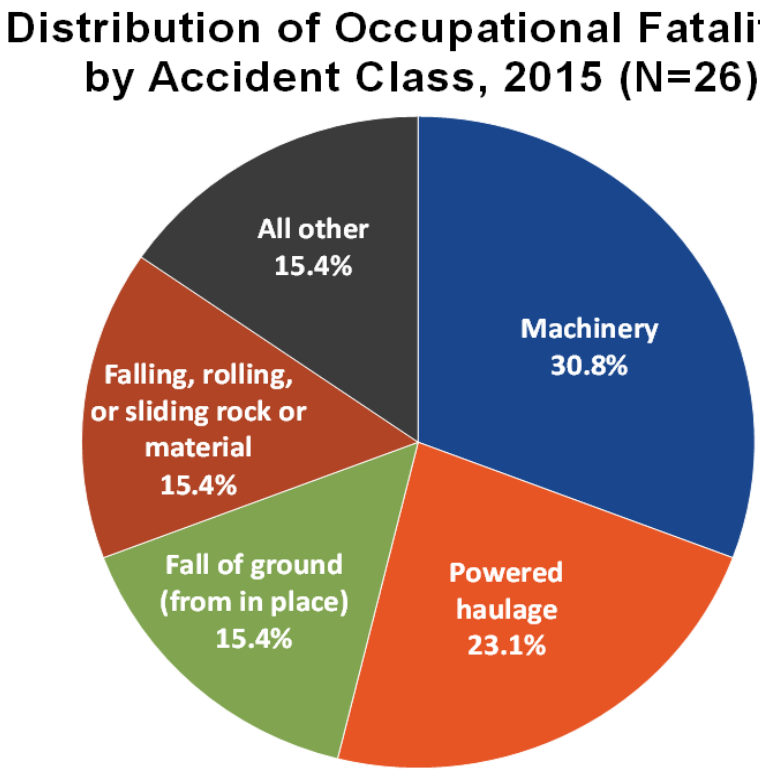

Fig. 1.2.2 : Percentage of different type of accident in working place [5] .

We can see, 15.4% people died due to the sudden change of environment. So it is very important to monitor the parameters that effect environment such as temperature, humidity etc. Continuous monitoring is a must which is often ignored. But with the help of technologies we planned to develop a protection system that will alert the user about adversity.

1.3 Motivation

With the development of science and technology people started working on oil mine, coal mine, gold mine etc. In all these fields people have to work many miles deep under ground. The environment are not suitable for working as well as environment changes suddenly [6] . But unfortunately necessary safety were not taken for labors. In the recent years there were many accidents occurred in mines which took away many valuable lives [7] .

Even now in 21th century often accidents occur in industries due to lack of proper monitoring of human health and working environment. But with the help of science and technology we can easily provide necessary safety for people working in both mine field and industries in a very small cost. From this idea we try to develop a project that will be cheap, lighter in weight and can be added to any uniform. As jacket and helmet are used by all employees in working field [8] . So we try to implement our project on jacket and helmet.

1.4 Objectives

The objectives of the project are given below

- To alert the user by a vibration from ultrasonic sensor on detecting obstacles.
- To measure the limit of toxic gas, temperature and humidity of surroundings using different sensors.
- To monitor system using wireless technology.

1.5 Report Outline

During planing and developing this project six chapters have been covered. The contents of different chapters are as follows

- **Chapter 1** presents the description, inspiration and goal of the project.
- **Chapter 2** discusses previous works related to our projects and their contribution in our project.
- **Chapter 3** discusses about the hardware those we have used to build our project.
- **Chapter 4** is the methodology of the project. It includes design of the project, block diagram and flowchart.
- **Chapter 5** shows the result we got after implementing our project.

- **Chapter 6** discusses about the projects application, advantages, limitations as well as the future development for practical use.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

Human lives are most valuable. With the development of science not only the scope and areas of work had been increased but also the risk of lives had been increased [9] . In unfavourable conditions such as mines field many safety steps are taken i.e. the toxic gas are cleared, fire extinguishing system are kept etc [10] . Again All these system are expensive as well as there is not kept any scope to monitor human health regularly which can be affected by adverse environment anytime [11] . As science has improved a lot so there are many technologies which are cheap but can be used for greater purpose. We try to utilize the technology around us to develop a protective gear which not only give precautionary safety but also provide regular safety by constant monitoring of human health and working environment.

2.2 Review of previous works

There were many works related to our project which had been done by some scholars in the recent year. Some of them are discussed below

2.2.1 GSM based Power Monitoring and Controlling System using Arduino

Over the past few decades, communication technology has evolved very rapidly. It has already established its importance in sharing all kinds of events around the world. In addition to exchanging information, it is also used for remote control of machines and electronic equipment [12] . In our daily lives, we use many such devices at home, office and public places. Each device requires some kind of operational control for which it has an HMI (Human-Machine Interface) which is an integrated project of measurement and control system. The user can monitor electrical parameters like voltage, current, power and send text to the user using GSM module automatically and execute user commands in GSM module if power exceeds certain limit. The project uses Arduino UNO which is common technology. The Arduino provides some built-in memory to hold the board's Microcontroller code [13] . The code is programmed using the Arduino programming language.

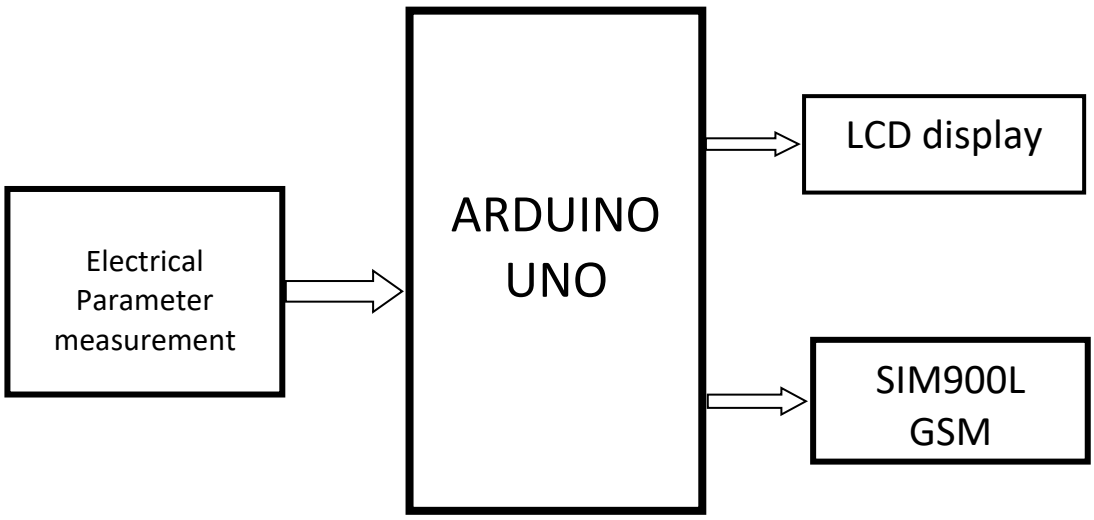

Fig. 2.2.1.1 : Block diagram for system modeling and design [14] .

Fig. 2.2.1.1 shows the block diagram of the project GSM based power controlling and monitoring using Arduino. It is a Arduino based project with a lot different input and output. In the input part there is different sensors which continuously asses the parameter. Arduino process them and shows them to LCD connected at the output. Using At command data are send to user and commands are executed the instructions provided by message from the user.

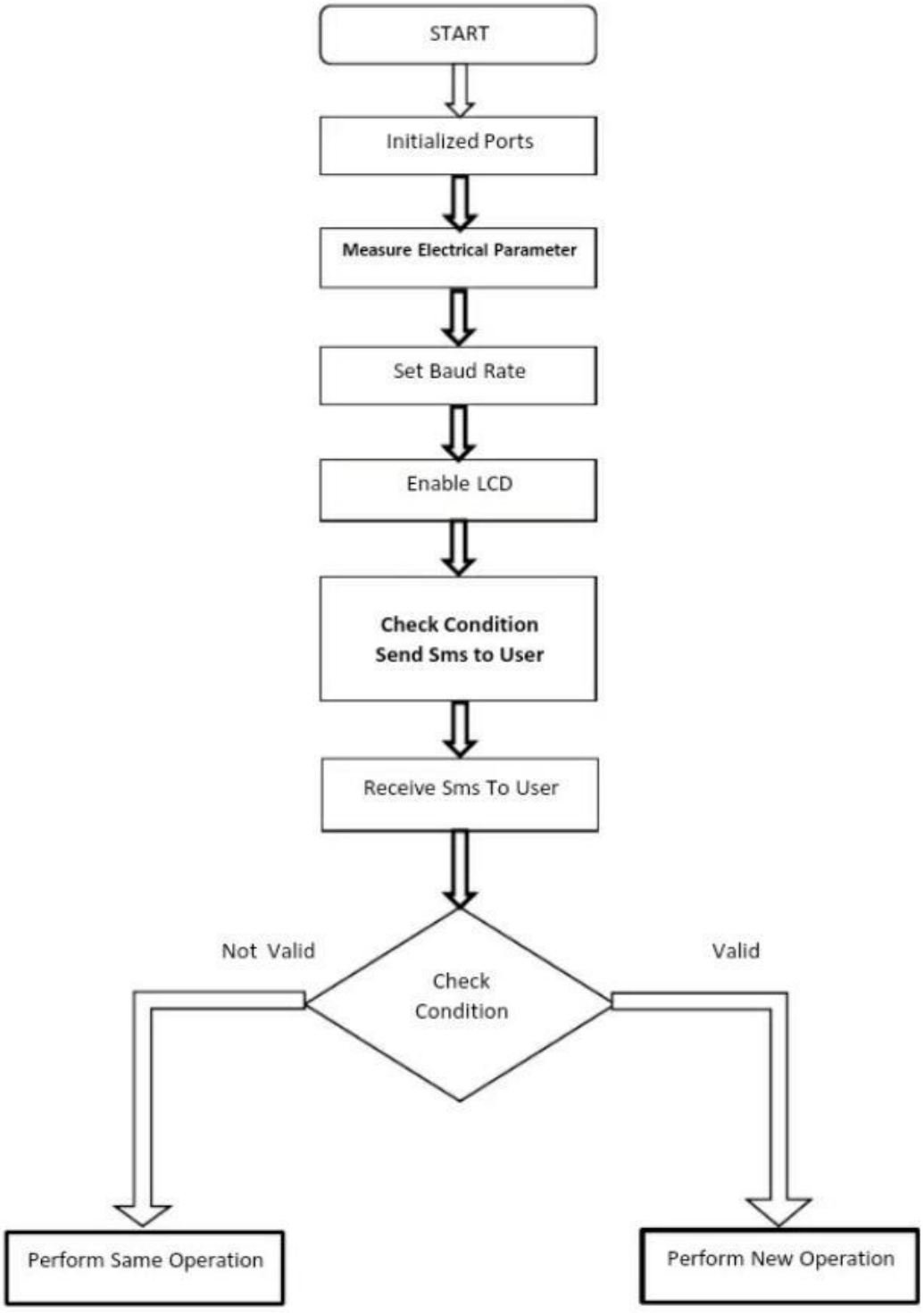

Fig. 2.2.1.2 : Flow chart for system modeling and design [15] .

Fig. 2.2.1.2 shows the flowchart of the project GSM based power controlling and monitoring using Arduino. When the system is powered with source, it initialize all the ports and start taking data from the sensors using Arduino. Then baud set is set and data are shown in LCD. Then it send message using AT command if conditions are fulfilled. Then it received message from user and execute the command given by the user.

2.2.2 Ultrasonic sensor based distance Measurement

Nowadays, there are some difficulties in getting the distance we want to measure. Although, measuring tape is an easy option, but this type of tool will have the limitations of manual error [16] . Previously, engineers have created a range finder module but in the end, they found that the module has many disadvantages such as distance limitations, different results for different color barriers and a calibration required every time before it starts to be used [17] . Manual distance measurement is always done due to human error [18] . Accurate and accurate measurement of short range distances is the main objective of this project. This project designed a ultrasonic high precision and low cost non contact distance measurement system using Microcontroller.The PIC16f877a microprocessor reduces the system's cost, while the HC-SR04 ultrasonic transducer module makes it non-contact. The ultrasonic sensor's recommended range is 2 cm to 4 m with a 3 mm accuracy. The module for ultrasonics sends out ultrasonic sound waves at a non-audible frequency of 40 kHz, then listens for the echo. A reference to the source The output wave form's time period is related to the distance between the source and the receiver. And the object from which the distance is being calculated. The Microcontroller receives the output signal and executes the instructions. It then processes the relevant data and shows the matching measured distance on the screen. LCD (liquid crystal display) display The results of the example tests show that the system can reliably calculate distances from any item to the ultrasonic wave generator's source, between which distances are being measured. The percentage of error between the measured and real distances is then determined. The performance test reveals that the intended system performs admirably.

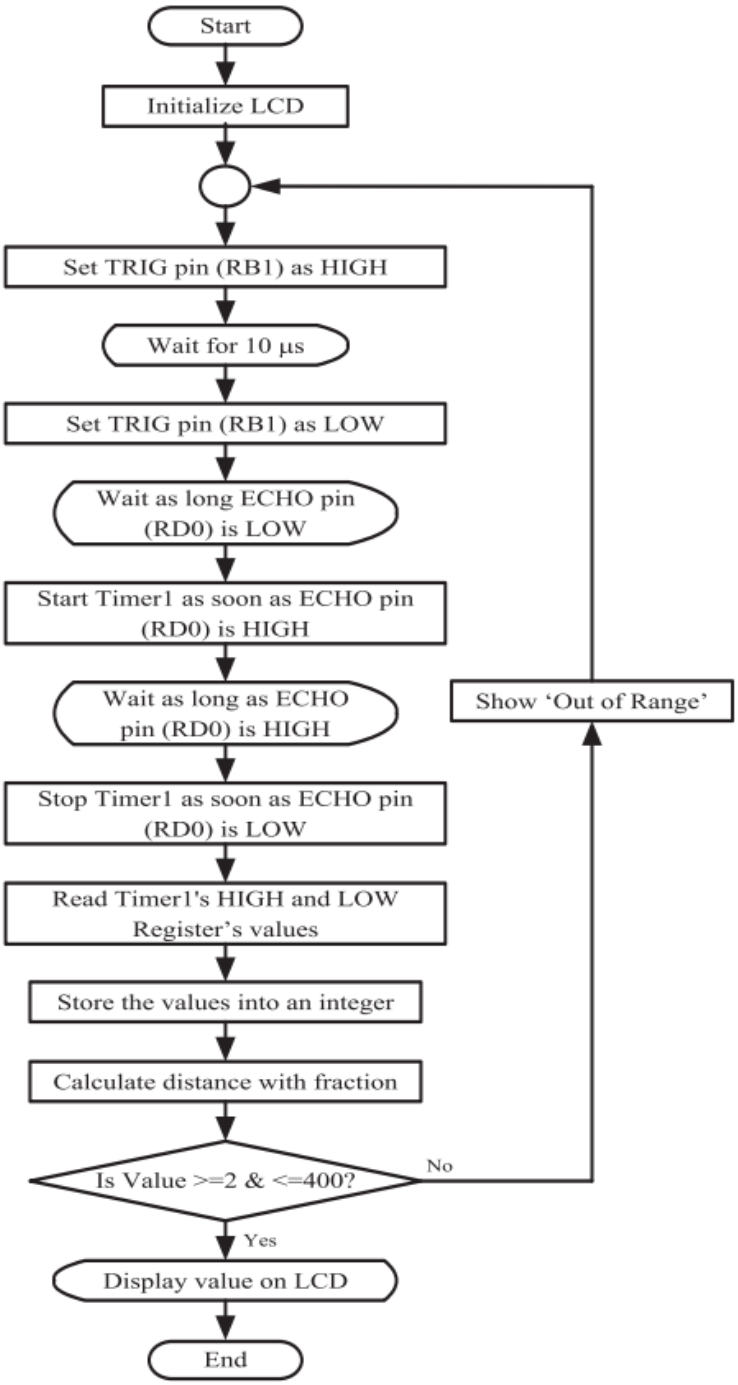

Fig. 2.2.2 : Flowchart of the project Ultrasonic based distance measurement [19] .

Fig. 2.2.2 shows the flowchart of the project Ultrasonic based distance measurement. When Microcontroller is powered with source, it initialize the LCD connected with it. Then it set trig pin High for 10 microseconds and sensor emits a ultrasound of 40kHz. At the same time echo pin and Timer connected with Microcontroller is set High.

After 10 microseconds trig pin set low. At the same time echo pin is set low and Timer record the data of echo. Using the velocity of sound (340 ms^{-1}), distance is measured. If the obstacle within the range of 2cm to 400cm, it is shown in the LCD.

2.2.3 Gas Leakage Detection System

A gas detector is a device that detects the presence of gas in an area, often as part of a system. These types of devices can detect gas leaks or other emissions and interface with a control system so that a process shuts down automatically.

Gas leak detection is the process of detecting potentially dangerous gas leaks by sensors [20] . These sensors usually use an audible alarm to warn people if a dangerous gas is detected. Exposure to toxic gases can also occur in operations such as painting, smoke, refueling, construction, excavating contaminated soil, landfill operations, entering confined spaces, and so on. Gas sensors, and semiconductor sensors. Most recently, infrared imaging sensors have been used All of these sensors are used for a wide range of applications and are found in industrial plants, refineries, pharmaceutical manufacturing, smoking facilities, paper pulp mills, aircraft and shipbuilding facilities, digestion operations, wastewater treatment facilities.

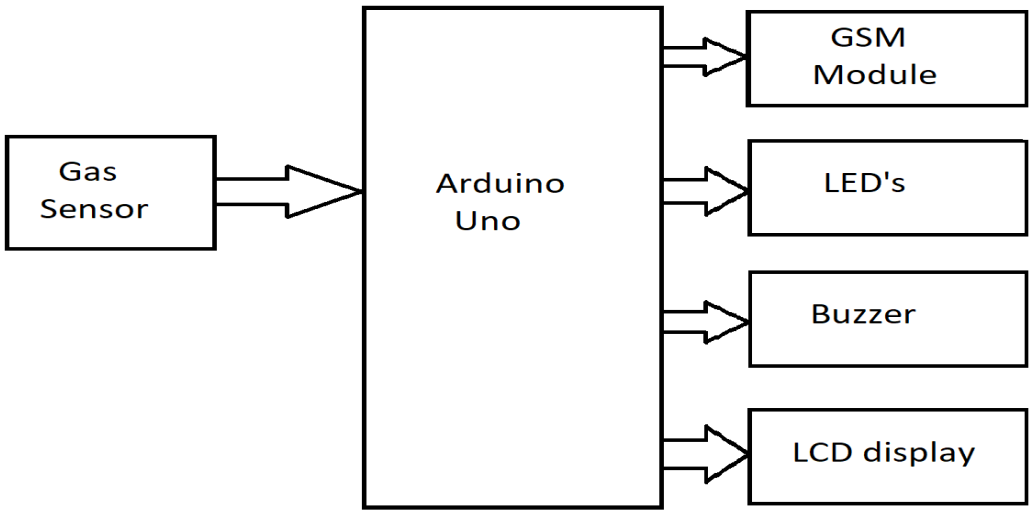

Fig. 2.2.3 : Block diagram for system design [21] .

Fig. 2.2.3 shows the block diagram of the project Gas leakage detection system. It is a Arduino based programme with single input and multiples output. When the system is powered with source, gas sensor initialized and asses the surroundings. The LCD

connected with Arduino displays a message about normal environment. When sensor detects a dangerous gas, LED connected with the Arduino set High and buzzer start to make noise to alert people and LCD displays a message about emergency conditions. At the same time, Arduino use AT command to send message using GSM module.

CHAPTER 3

HARDWARE DESCRIPTION

3.1 Introduction

To build this projects we used a lot of apparatus. There were a lot of alternatives for all components. So to find out the best components we had to study a lot about all the components. Again we want to make our project as cheaper as possible as well as effective as much as possible. So finding out the best components was not easy.We have chosen all our components depending on three criteria. These are effectiveness of the components, suitability for our project and price of the component. We used a lot of components such as ARDUINO, MICROCONTROLLER, gas sensor, heart rate sensors, temperature and humidity sensors, ultrasonic sensors and many other useful minor hardware. All the important components of our project are discussed In this chapter.

3.2 Main components

- Arduino
- MIicocontroller
- Temperature and Humidity sensor
- Gas sensor
- Heart rate sensor
- Ultrasonic sensor
- GSM module
- Voltage regulator
- RF Transmitter and Receiver
- Monopole antenna

3.2.1 Arduino

There are many different boards in the Arduino family, but in our project we focuses on the newest member: The Arduino NANO. It uses an ATmega328P chip. Out of all the boards in the Arduino family, it has the smallest footprint (needs less breadboard space). This board is also cheaper than other boards like the Arduino UNO and comes with a USB port right on the board (no need for an adapter to upload sketches).

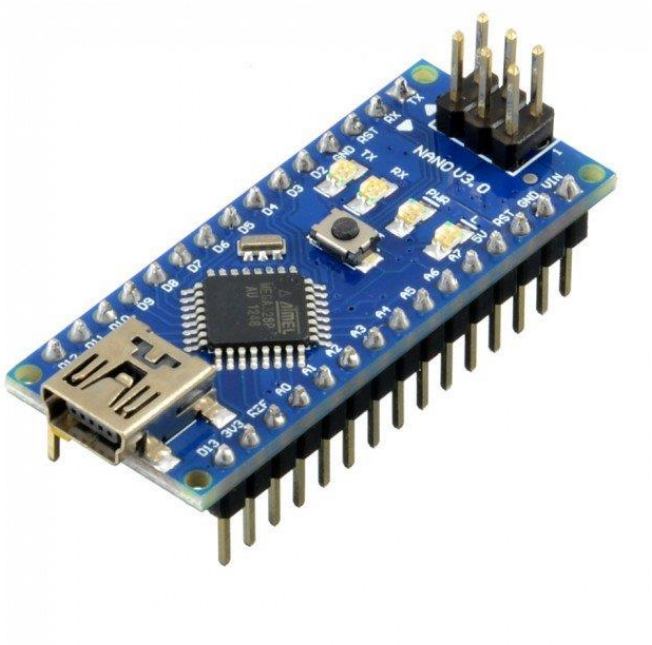

Fig. 3.2.1 : ARDUINO NANO [22] .

It uses 3.3V logic instead of 5V like most Arduino's, so it's not compatible with most sensors and accessories if they require 5V. It has 28 pins supporting both analog and digital input and output. **Fig. 3.2.1** shows an ARDUINO NANO.

3.2.2 Microcontroller

There are a lot varieties of Microcontroller available in market. We chose PIC16F73. Because it is cheap and suitable for operating ultrasonic sensor. We have used it in the helmet to build obstacles sensing circuit.

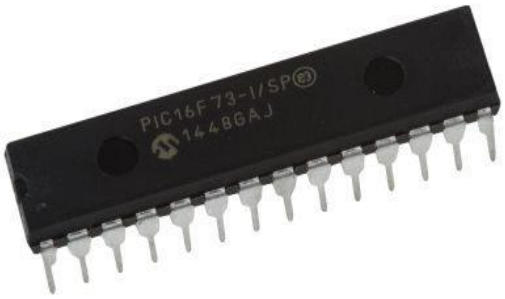

Fig. 3.2.2 : Microcontroller [23] .

Fig. 3.2.2 shows a PIC16F73 Microcontroller. The PIC16F73 is a 8-bit Flash-based CMOS Microcontroller with an internal instruction cache. The entire VDD range is readable in normal operation for the flash program memory. It is addressed indirectly via Special Function Registers (SFR). The PIC16F73 has three operating modes: Real-Time Counter with One shot, Real-Time Counter with Auto Reload, and Free Running Timer or Watchdog Timer modes. In addition to these timer functions, the device also includes a watchdog system to generate a reset when needed. The Watchdog can be configured for either an active high or low reset output based on the WDR. Reset input is active high, therefore the PIC16F73 Microcontroller will be reset when VDD is applied.

3.2.3 Temperature and Humidity sensor

We have planned to build a protection system which can capable of sensing elements those effect the environment such as temperature, humidity etc. For this reason we used different sensors. We used DHT11 for temperature and humidity measurement shows in **Fig. 3.2.3**. We chose this sensor because it can measure both humidity and temperature at the same time.

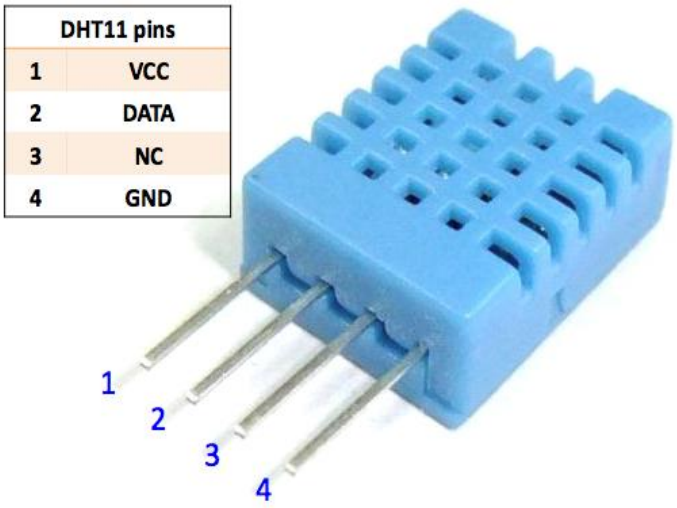

Fig. 3.2.3 : Temperature and humidity sensor [24] .

The DHT11 sensor is the first to break the 1mm manufacturing thickness limit, adding weightless sensors for everything from door handles to human skin by measuring the contact temperature. The ST-manufactured DHT11 sensor which has a thickness of only 0.3mm, is the thinnest in the world to measure contact temperature using thermistor. The DHT11 has a thickness that can be controlled to within 0.1mm without depending on the manufacturing process, enabling integration with all kinds of surfaces including human skin. The sensor measures both contact temperature and surface temperatures, providing highly accurate readings down to 0.2°C.

3.2.4 Gas sensor

To determine the presence of toxic gas we used a gas sensor to continuously asses the surroundings. There are a lot varieties of gas sensors available in market but we have chosen MQ2 because of its ability to sense a lot varieties of gases.

Fig. 3.2.4 : Gas sensor [25] .

Fig. 3.2.4 shows a MQ2 gas sensor. We chose it because it is cheap and can also effective for a lot variety of toxic gas. MQ2 sensor is a relatively new type of gas sensor that can detect highly combustible gases like methane with high sensitivity.The MQ2 sensor is also more suited for detecting hydrogen, due to its electrostatic properties. It consists of a sensing material that changes resistance when it comes into touch with the gas. The basic working principle of this sensor is that it functions as a variable resistor whose resistance varies according to the number of detected gas molecules. When the molecular density of the gas is low, the resistance value is high,

which means it will detect high concentrations of gas. When there is a high number of molecules present in the air, the sensor's internal resistance decreases considerably.

3.2.5 Heart rate Sensor

Heart rate is an important parameter of human body. Heart rate changes with situations and health. So it is important to monitor heart rate with a sensor. We have used pulse sensor for this purpose. For measuring heart rate of the user we had to select a heart rate sensor.

Fig. 3.2.5 : Heart rate sensor [26] .

There are a lot of sensor are available but we have chosen pulse sensor for measuring heart rate. Because Pulse Sensor is a well designed plug and play heart rate sensor for Arduino. It is easy to use and operate. **Fig. 3.2.5** shows the pulse sensor we used for our project.

3.2.6 Ultrasonic sensor

Ultrasonic sensor is used to determine the presence of obstacles. It is used in helmet circuit to alert user about presence of obstacles. **Fig. 3.2.6** shows the ultrasonic sensor we have used in our project. It is called HC SR-04 ultrasonic sensor.

Fig. 3.2.6 : Ultrasonic sensor [27] .

An ultrasonic sensor is a device that uses ultrasonic sound waves to measure the distance to an object. An ultrasonic sensor sends and receives ultrasonic pulses with a transducer to convey information on the proximity of an object. Ultrasonic sensors are widely used in many industries, including automotive, transportation, robotics, manufacturing, agriculture, and medicine. It can't reach very far into a room or open space but works well with obstacles that might be between 1 and 3 feet from the sensor, such as doors and walls. Ultrasonic sensors commonly operate in frequencies between 40 kHz to 120 kHz with 140 kHz frequently used because it provides good resolution while minimizing cost and complexity.

3.2.7 GSM module

A GSM modem or module is a hardware device that allows you to connect your computer to a remote network using GSM mobile phone technology. **Fig. 3.2.7** shows the GSM module we have used. It is used with ARDUINO to send a message to specific numbers by AT command. The SIM800L is a GPRS enabled cellular module that can send and receive SMS, as well as make and receive voice calls. This module's low cost, small size, and quad-band frequency support make it an excellent option for any project requiring long-range communication.

Fig. 3.2.7 : GSM module [28] .

SIM800L is a miniature cellular module which allows for GPRS transmission, sending and receiving SMS and making and receiving voice calls. Low cost and small footprint and quad band frequency support make this module perfect solution for any project that require long range connectivity. This module have two antennas included. First is made of wire (which solders directly to NET pin on PCB) - very useful in narrow places. Second - PCB antenna - with double sided tape and attached pigtail cable with IPX connector. This one have better performance and allows to put your module inside a metal case - as long the antenna is outside.

3.2.8 Voltage regulator

A voltage regulator is a piece of electrical or electronic equipment that maintains the voltage of a power source within acceptable limits. The voltage regulator is required to maintain voltages within the permissible range, which can be tolerated by electrical equipment powered by it. **Fig. 3.2.8** shows a LM-7808 voltage regulator that we have used. The LM7808 series of three terminal positive regulators are available in the TO-220 package and with several fixed output voltages, making them useful in a wide range of applications.

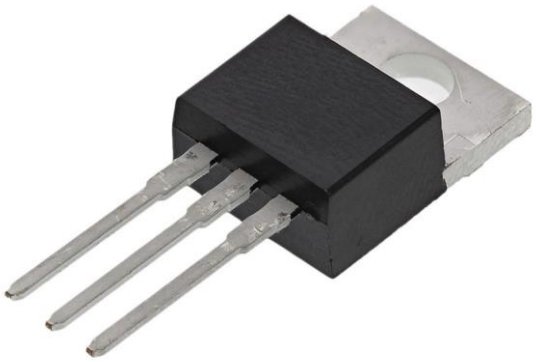

Fig. 3.2.8 : Voltage regulator [29] .

Each type employs internal current limiting, thermal shut down and safe operating area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents. It can sustain up to 25 volt as input and constantly supply 5volt as output. It is capable of thermal over voltage protection and short circuit protection.

3.2.9 RF Transmitter and Receiver

The RF transmitter picks up data and transmits it wirelessly via its antenna to the receiver. The transmitted data is received by the RF receiver, which is operating at the same frequency as the transmitter.

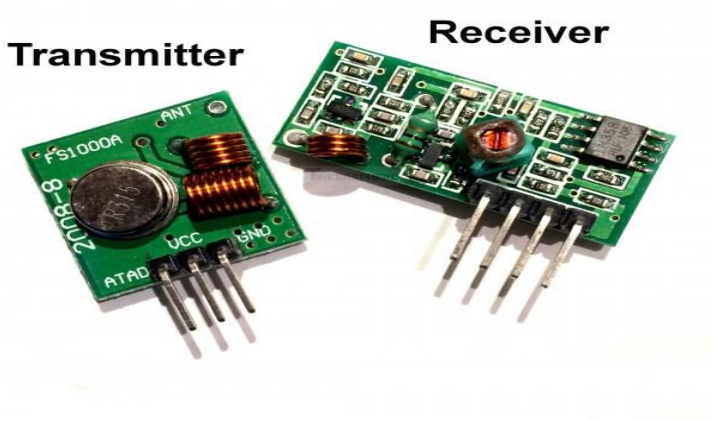

Fig. 3.2.9 : RF transmitter & receiver [30] .

We choose RF modules since they have a high number of applications and are more popular than IR. Because it requires two components to transmit and receive data, we utilize RF transceiver modules. Only a transmitter can send information, while only a receiver can receive it, so data may only move from one end to the other but not in the opposite direction.

3.2.10 Monopole Antenna

A monopole antenna is a radio antenna made up of a straight rod-shaped conductor that is positioned perpendicularly over a conductive surface called a ground plane. Between the ground plane and the lower end of the mono pole, the driving signal from the transmitter is supplied, or the output signal from receiving antennas is received.

Fig. 3.2.10 : Monopole antenna [31] .

The antenna feedline is connected to one side of the mono pole and to the ground plane, which in most cases is Earth. In contrast, a dipole antenna consists of two identical rod conductors with a signal from the transmitter applied between them. The monopole antenna has an omnidirectional pattern in the horizontal plane, making it simple to design and lightweight. The cellular phone handset antennas are presently required to be small in size and placed within the device close to a large PCB, which serves as a ground plane.

CHAPTER 4
METHODOLOGY

4.1 Introduction

The system is divided into three basic steps. These are data assemble, process them to display into LCD and sending signal to mobile on emergency situations. The gas sensor, heart rate sensor and temperature and humidity sensor assemble data and send to Arduino for further process, Arduino process them for displaying in LCD and use a GSM module to send signal to mobile on emergency situation. This chapter covers the blueprint of the project. System design, block diagram and flow chart of the project are described in this chapter.

4.2 Block Diagram

This chapter covers the basic three block diagrams of the system. The transmitter block diagram, receiver block diagram and obstacle sensing block diagram. Transmitter block diagram shows covers the sensors connections and operations, receiver block diagram shows the LCD and receiver connections of the system to read the data accumulate by the sensors and obstacle sensing block diagram shows the connection of obstacles sensor with Microcontroller and respond of output.

4.2.1 Transmitter Block Diagram

The transmitter block diagram shows in **Fig. 4.2.1**. It is a simplified block diagram. We used ARDUINO to build our project. In the figure we can see all the input and output component which are operated by Arduino. We attached an emergency button with the gear. It is a push button which is used by the user to inform others about his unfavourable conditions. Again he can use to alert other if he notice anything unusual in the working place. When he pressed the button the buzzer connected with the Arduino at the output starts to make noise as well as a signal is transmitted through RF transmitter to receiver using Arduino.

We have developed a sensor based project using different sensors. Temperature sensor, gas sensor and heart rate sensor are used to asses the surroundings. From **Fig. 4.2.1** we can see all are connected as input component with Arduino. All three sensors continuously asses the surroundings and Arduino process them to send to receiver using RF transmitter. The antenna is used for convenient signal transmission.

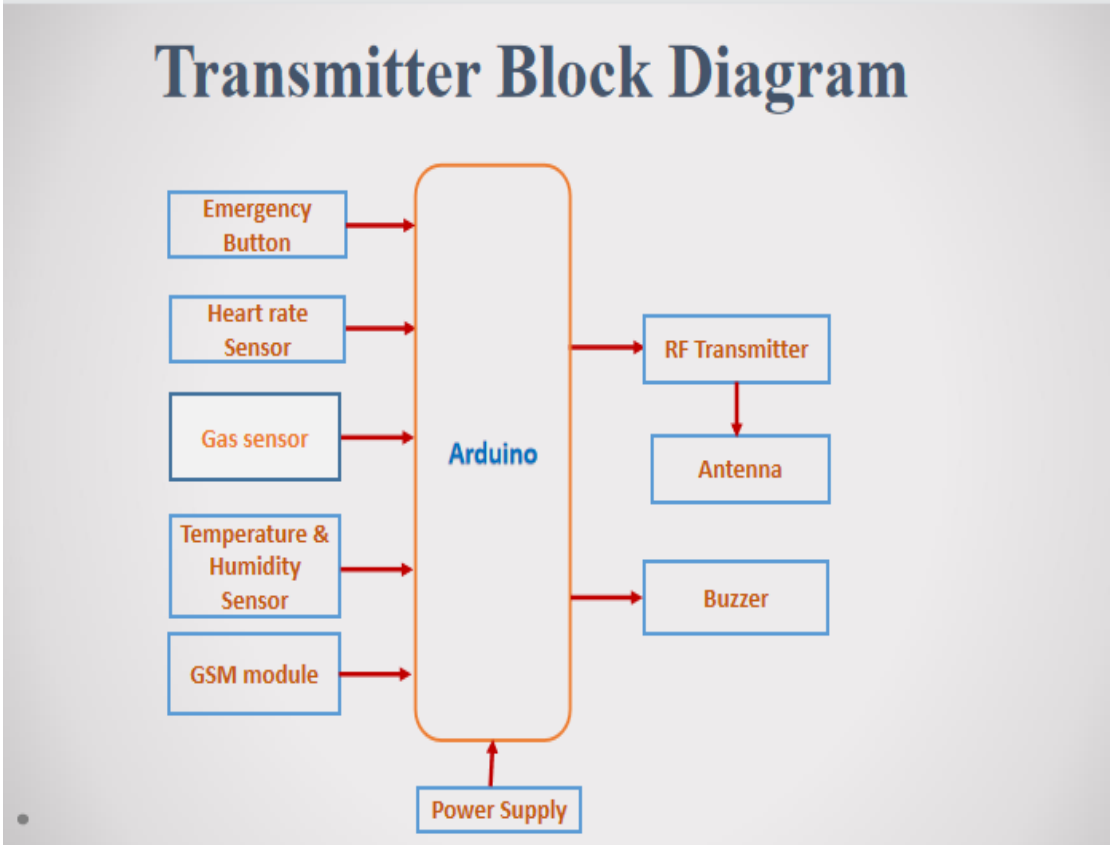

Fig. 4.2.1 : Transmitter block diagram

In case of emergency situations we have develop a system to send signal to outside using GSM module. It is also controlled by Arduino. Arduino send AT command to GSM module to transmit signal to ask for help. Though the GSM and other input are used in two different circuit but as they both transmit signal so for convenience we have added both in one block diagram.

4.2.2. Receiver Block Diagram

Transmission circuit continuously transmit signal which are received and processed in receiver circuit. **Fig. 4.2.2** shows the receiver circuit block diagram. This is also an Arduino based circuit. All the components RF receiver, buzzer and LCD are connected with Arduino as input and output.

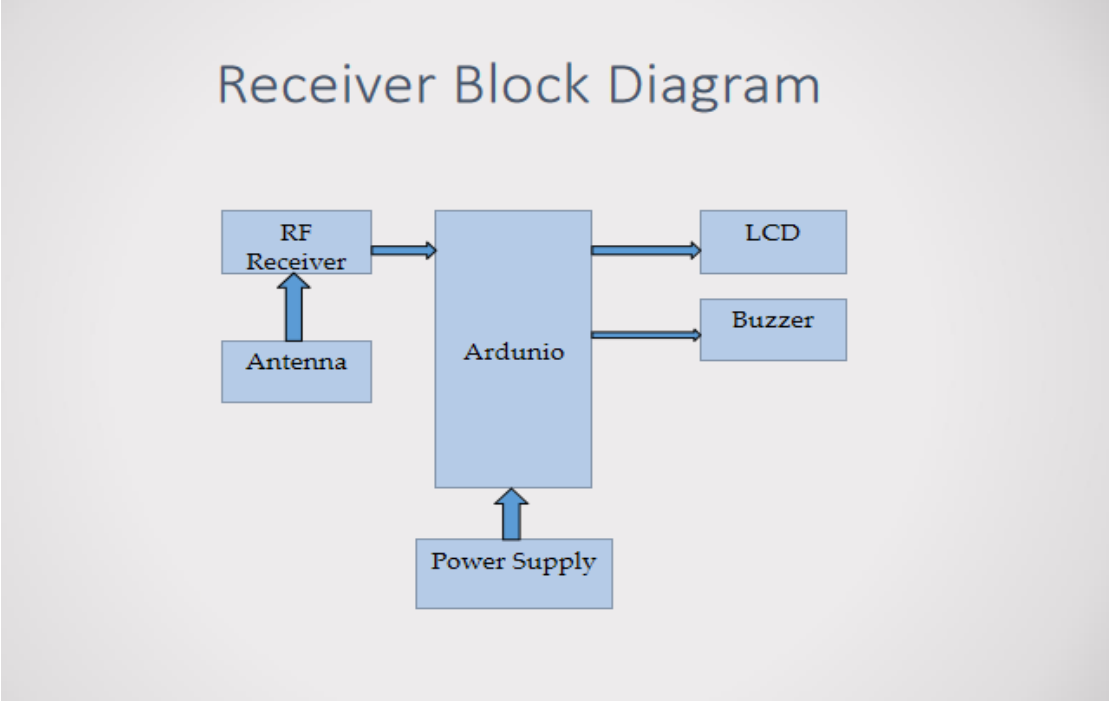

Fig. 4.2.2 : Receiver block diagram

The transmitted signal are received by RF receiver and Arduino process them to display in LCD. In the transmission circuit when the emergency button is pressed, the signal is also transmitted and the buzzer connected at the output of Arduino also makes noise. The antenna is used for the receiver to receive signal conveniently. The whole system is powered by two batteries.

4.2.3 Obstacle Sensing Block Diagram

For sensing the presence of obstacle we have used ultrasonic sensor which is placed on helmet. We have used Microcontroller for operating Ultrasonic sensor.

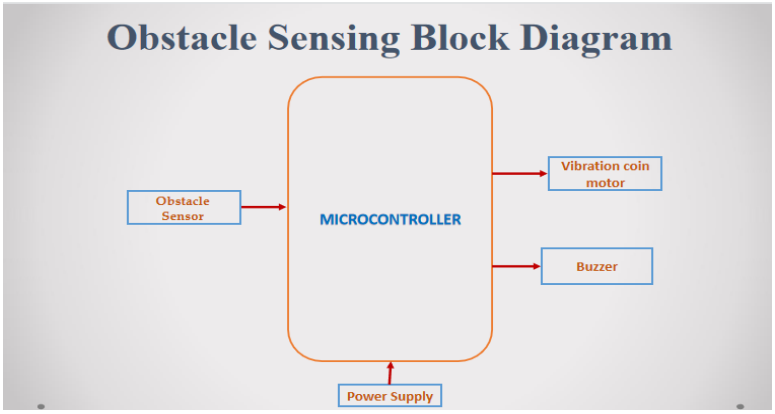

Fig. 4.2.3 : Obstacle sensing block diagram

Because it is a simple programme and using Arduino will increase cost of the project. **Fig. 4.2.3** shows the block diagram of obstacle sensor circuit. Ultrasonic sensor continuously sense the presence of obstacles. When a obstacle comes within predefined range the buzzer start to make noise and motor starts to vibrate to alert user. The whole system is powered by a pair of batteries.

4.3 Circuit Design

The project is divided into four basic parts. These are jacket circuit, obstacle circuit, receiver circuit and GSM circuit. We can learn about the whole project from the circuit diagram of these four basic parts.

4.3.1 Jacket Circuit

Jacket Circuit is shown on **Fig. 4.3.1**. We used Arduino NANO to build this circuit. Temperature and humidity sensor, gas sensor and heart rate sensor are used in this circuit to continuously asses the environment.

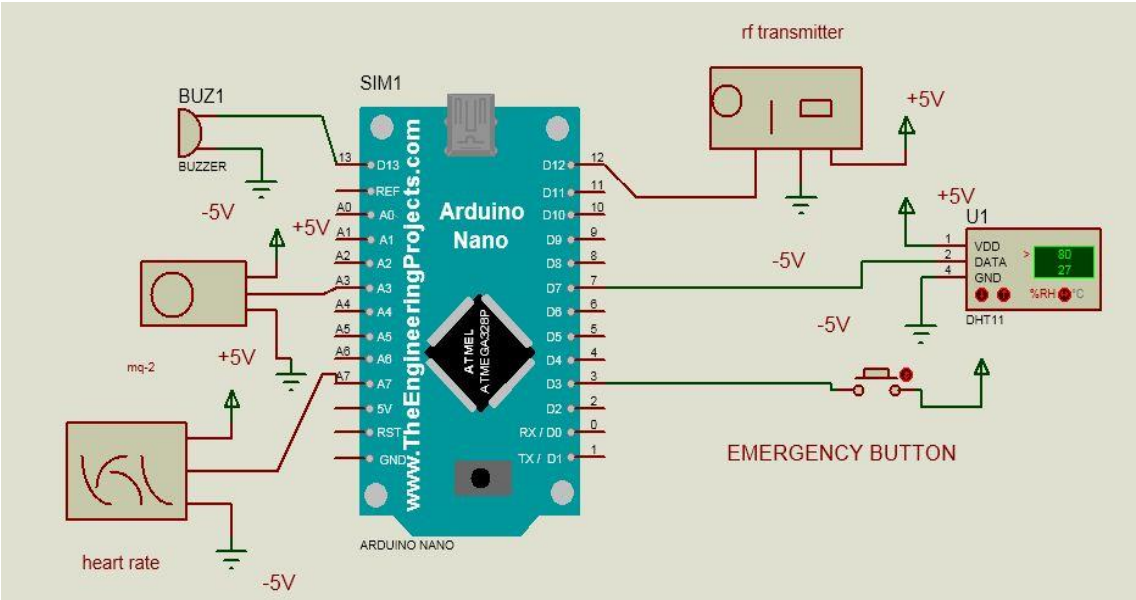

Fig. 4.3.1: Jacket circuit

We have used DHT11 as temperature and humidity sensor, MQ2 as gas sensor and Pulse sensor as heart rate sensor. MQ2 and Pulse sensor are connected with Arduino analog pin because of their nature of output while DHT11 is connected with Arduino

digital pin because of its output nature. Emergency button and buzzer are connected with digital pin as they provide digital signal. RF transmitter is connected with a digital pin of Arduino which we have defined in the programme.

4.3.2 Obstacle Sensing Circuit

Obstacle circuit covers the circuit that is used in helmet. **Fig. 4.3.2** shows the obstacle sensing circuit of the project. It is a Microcontroller based circuit. We used ultrasonic sensor to check the presence of obstacle. We picked HC SR-04 as ultrasonic sensor. The sensor is connected as input with the Microcontroller.

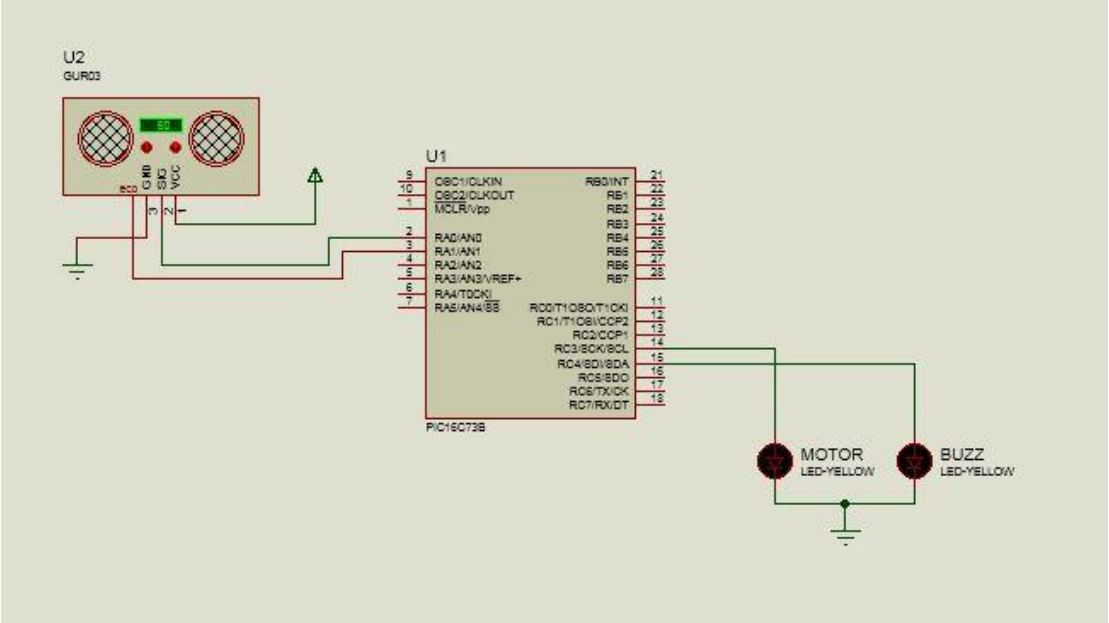

Fig. 4.3.2: Obstacle Sensing circuit

Ultrasonic sensor is connected with Port A pin of Microcontroller. A buzzer is connected as Output with the Microcontroller digital pin to alert user. Also for alerting user a motor is connected with the digital pin of Microcontroller. When HC SR-04 detects the presence of an obstacle within given range, the buzzer starts to make noise as well as the motor generate a vibration to alert user.

4.3.3 Receiver Circuit

Receiver circuit of the system is shown in **Fig. 4.3.3**. In the jacket circuit in **Fig. 4.3.1** we have seen our transmitter circuit. That transmitter circuit continuously transmit signal of sensor data which are received by the receiver and shown in LCD display.

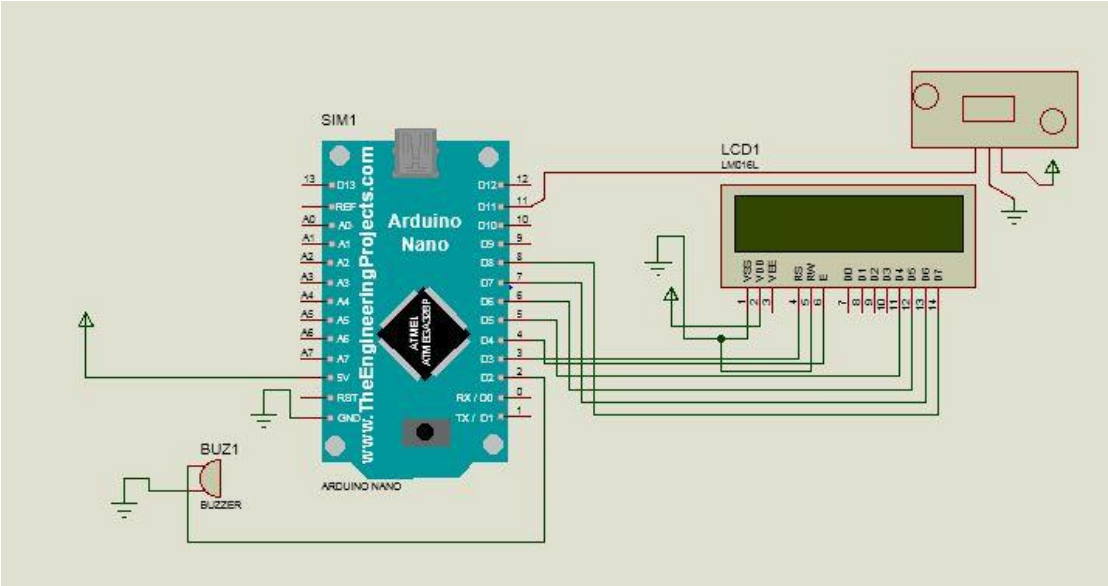

Fig. 4.3.3: Receiver circuit

The whole system is also operated by an ARDUINO. RF transmitter continuously receive signal from the transmitter. It is connected with a digital pin of Arduino because of its output nature. The pin is defined as RF receiver pin in the programme. Arduino receives data from transmitter and display them in the LCD which is connected with the Arduino. A buzzer is used in the receiver circuit connected with a digital pin makes noise when emergency signal is sent to receiver through transmitter from from jacket circuit.

4.3.4 GSM Circuit

In our project, in case of emergency situation user can press a button to send message to mobile for asking help from others. This is done with a GSM module combining it with ARDUINO. The circuit diagram is shown in **Fig. 4.3.4**. We have used SIM800L as GSM module. For transmitting and receiving signal GSM module's TX and RX pin is connected with Arduino's TX and RX pin.

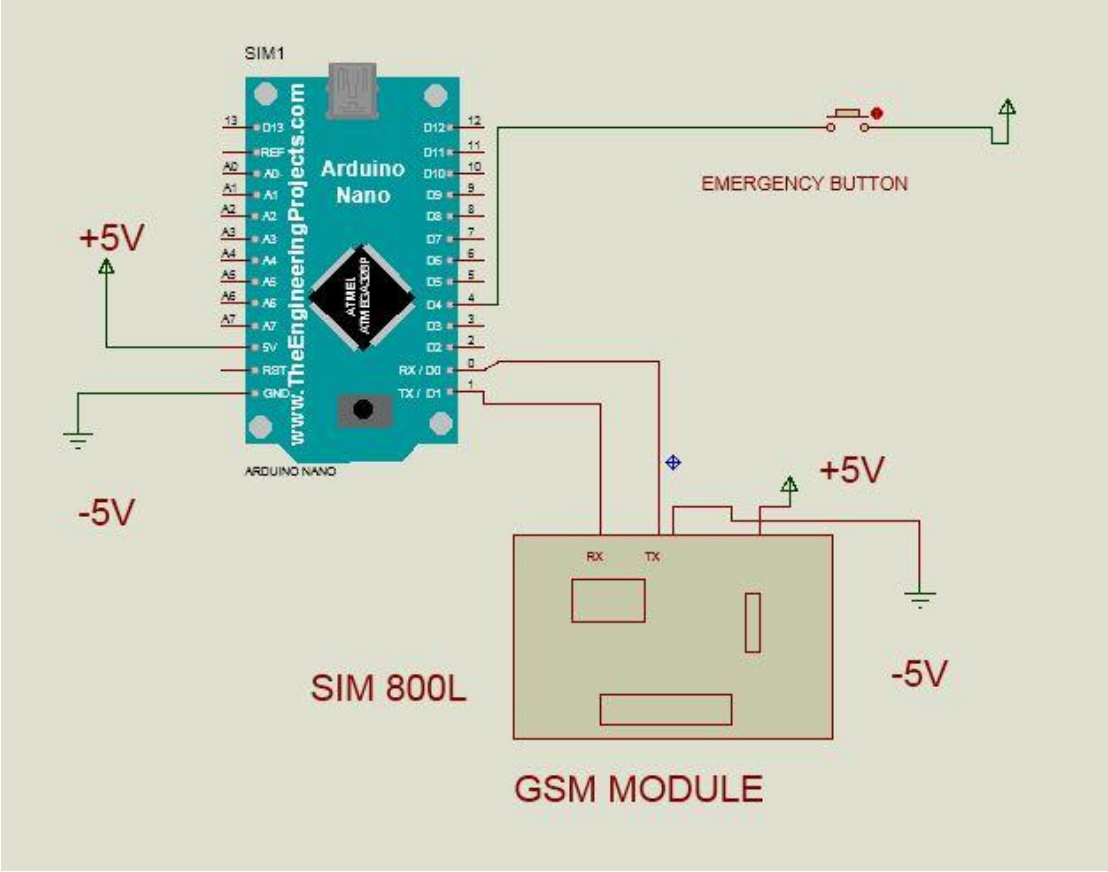

Fig. 4.3.4: GSM circuit

In case of emergency situation user press the button that is connected with a digital pin of ARDUINO. Then Arduino send AT command to GSM module and GSM module send message to specific numbers.

4.4 Flowchart

In this chapter we discussed the operation of our whole system. This chapter covers the working procedure of all the sensors, function of buzzer and message sending to mobiles to track user's location in a serial manner.

The flowchart of the whole project shows in **Fig. 4.4.1.** when we power the whole system, then three things start simultaneously. ARDUINO start working and three sensors of the jacket gas sensor MQ2, heart rate sensor Pulse sensor, temperature and humidity sensor DHT11 start operation. They collect data and check with their threshold point. Data are sent to receiver if threshold of the sensors are exceed . At the same time Arduino check the status of the button of jacket circuit. When the status of

the button is high, buzzer in the jacket starts to make noise as well as a signal is transmitted to receiver circuit through RF transmitter.

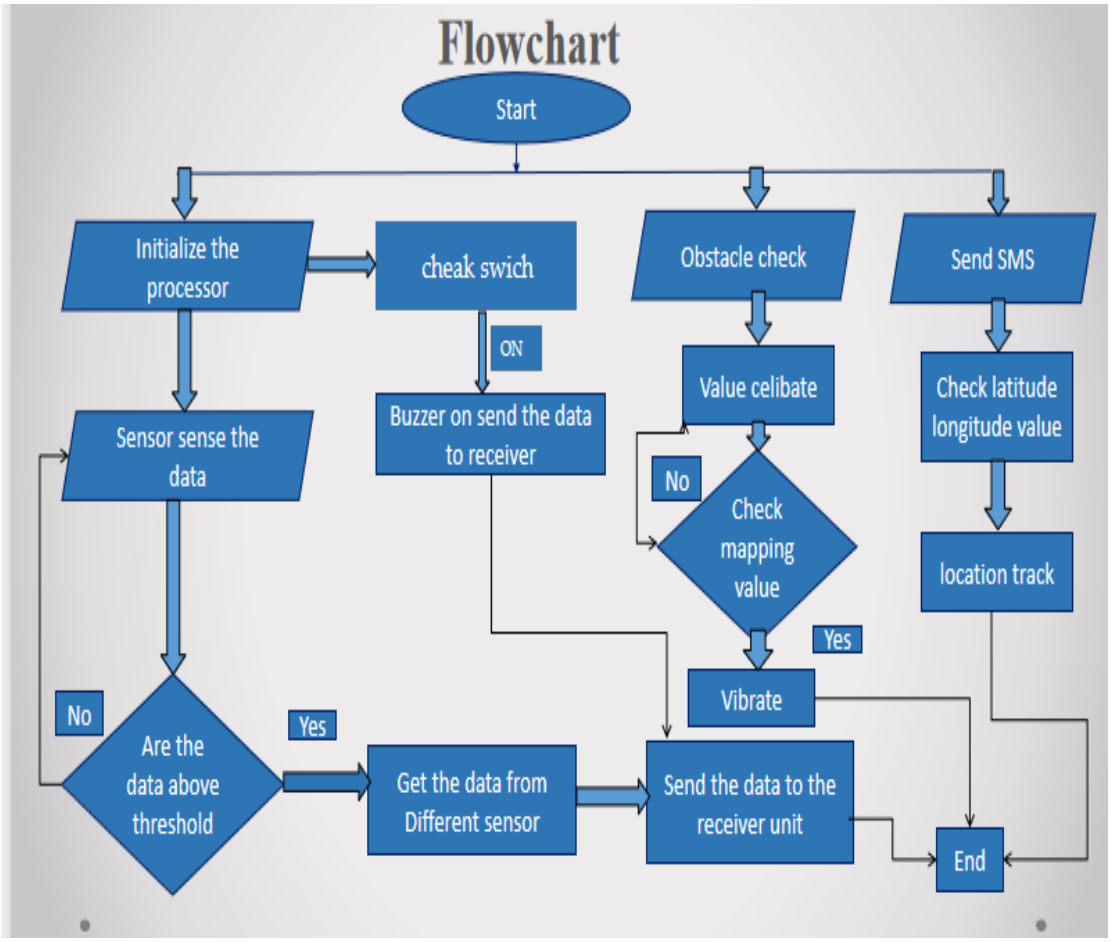

Fig. 4.4.1 : Flow chart

At the same time, ultrasonic sensor HC SR-04 starts sensing the presence of obstacle. It continuously check whether an obstacle comes within mapping value. It generates a vibration to notify user when an obstacle comes within mapping value.

Location tracking system is also activated when we start the system. Arduino check the status of button of GSM module circuit. When Status of the button is high, Arduino send AT command to GSM module to track location and send message to specific mobile number.

CHAPTER 5

IMPLEMENTATION AND RESULT

5.1 Introduction

The whole system is divided into three steps. These are- data accumulation by the sensors, send them to LCD by ARDUINO for further process and send emergency message to mobile using GSM technology. Data accumulation process is done by the ARDUINO combining with gas, heart rate and temperature and humidity sensor and MICROCONTROLLER combining with ultrasonic sensor. In this chapter, we exhibit all the results we got from the project after implementing it. We also include some photographs while we were testing the result of the project.

5.2 Project Review

The photographic representation of the project after implementation are shown in **Fig. 5.3.1 and Fig. 5.3.2**. The jacket which contain gas sensor MQ2, heart rate pulse sensor and temperature and humidity sensor DHT11are shown in **Fig. 5.3.1** at the right side of the jacket. We placed jacket circuit and GSM module circuit and flip flop circuit for LCD blink are at the left side of the jacket. On the other hand, **Fig. 5.3.2** represents the protective helmet. An ultrasonic sensor HC SR-04 is connected with the helmet which is operated by a MICROCONTROLLER.

5.3 Result and Discussion

In our project we have used three sensors MQ2, DHT11 and Pulse sensor to asses the parameters of the environment such as temperature, humidity etc and transmit those data using RF transmitter to Receiver circuit. RF receiver receives those data and Arduino shows those data to LCD of the receiver circuit. Again we have used GSM module to send message to some specific numbers on emergency situations. All the output are discussed in this chapter.

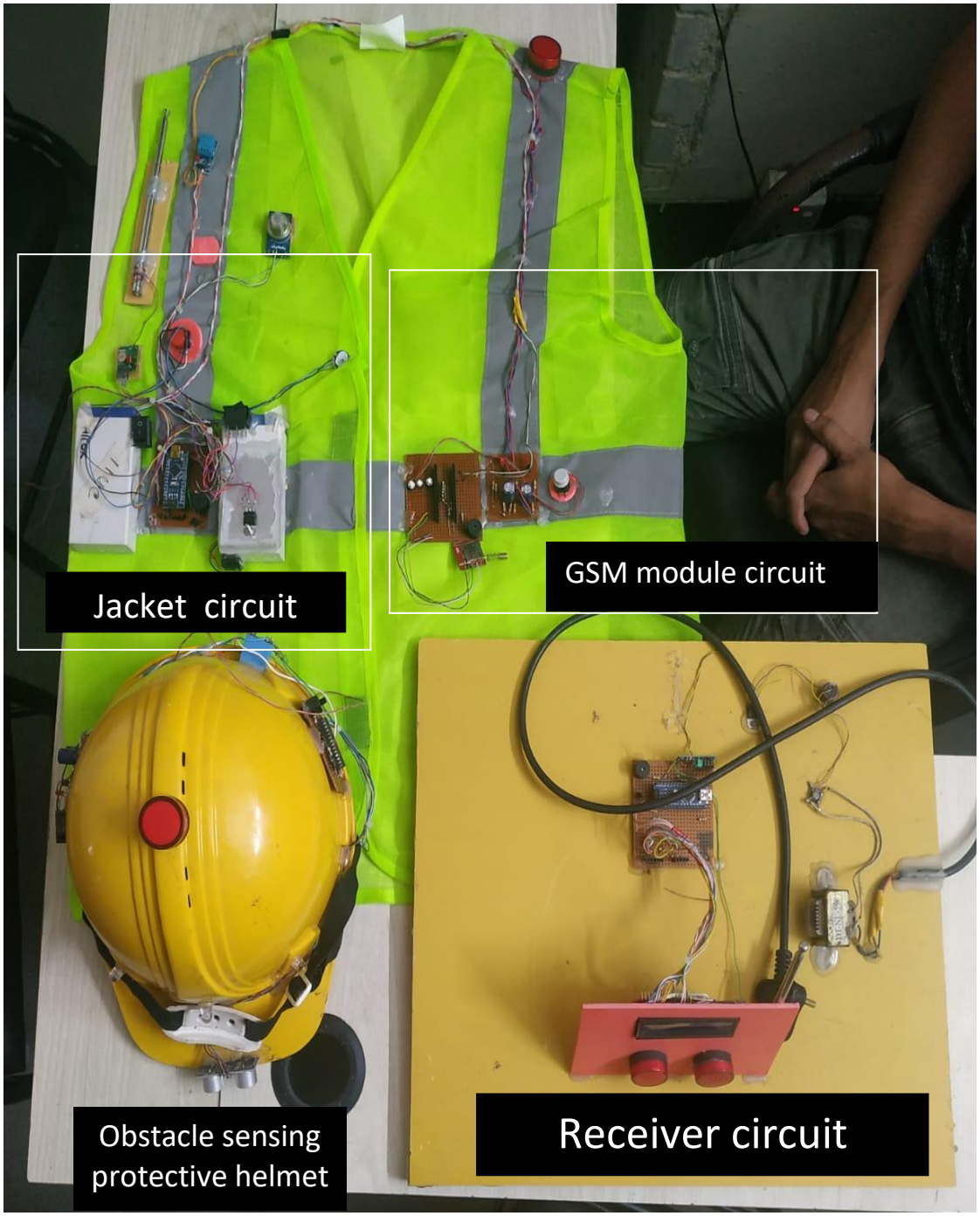

Fig. 5.3.1 : Project after implementation

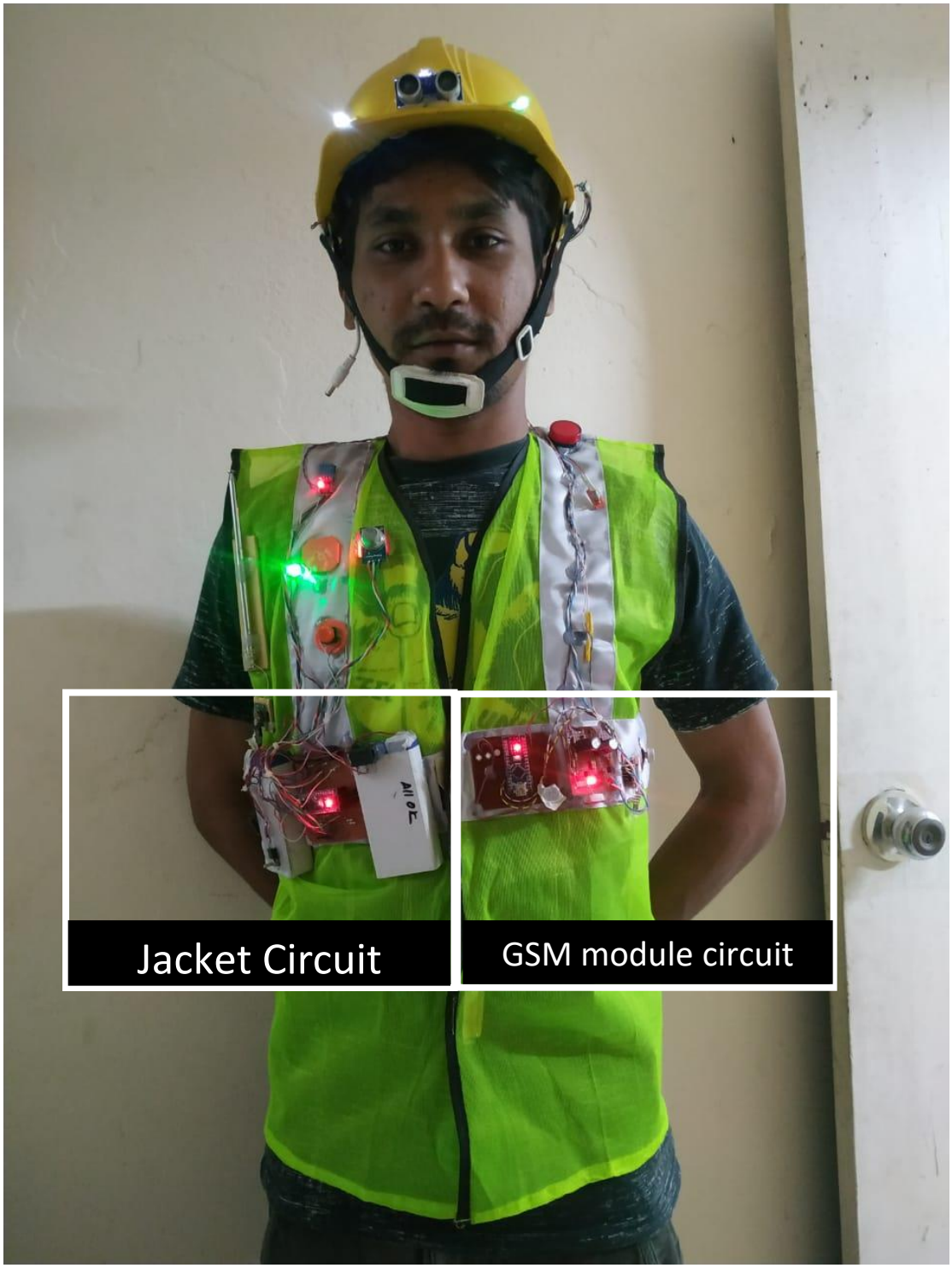

Fig. 5.3.2 : Project after implementation

Fig. 5.3.1 and **Fig. 5.3.2** show the result of our project after it was implemented and operated. All the data collected by MQ2 sensor, DHT11 sensor and Pulse sensor are processed by Arduino. Then they are transmitted to receiver for further analysis.These

data collected by the sensors are are shown in LCD screen in **Fig. 5.3.3.** The amount of gas present in the environment (25 PPM), heart rate of the user (84 BPM) and temperature (31^0 C) and humidity (51%) of surroundings are shown.

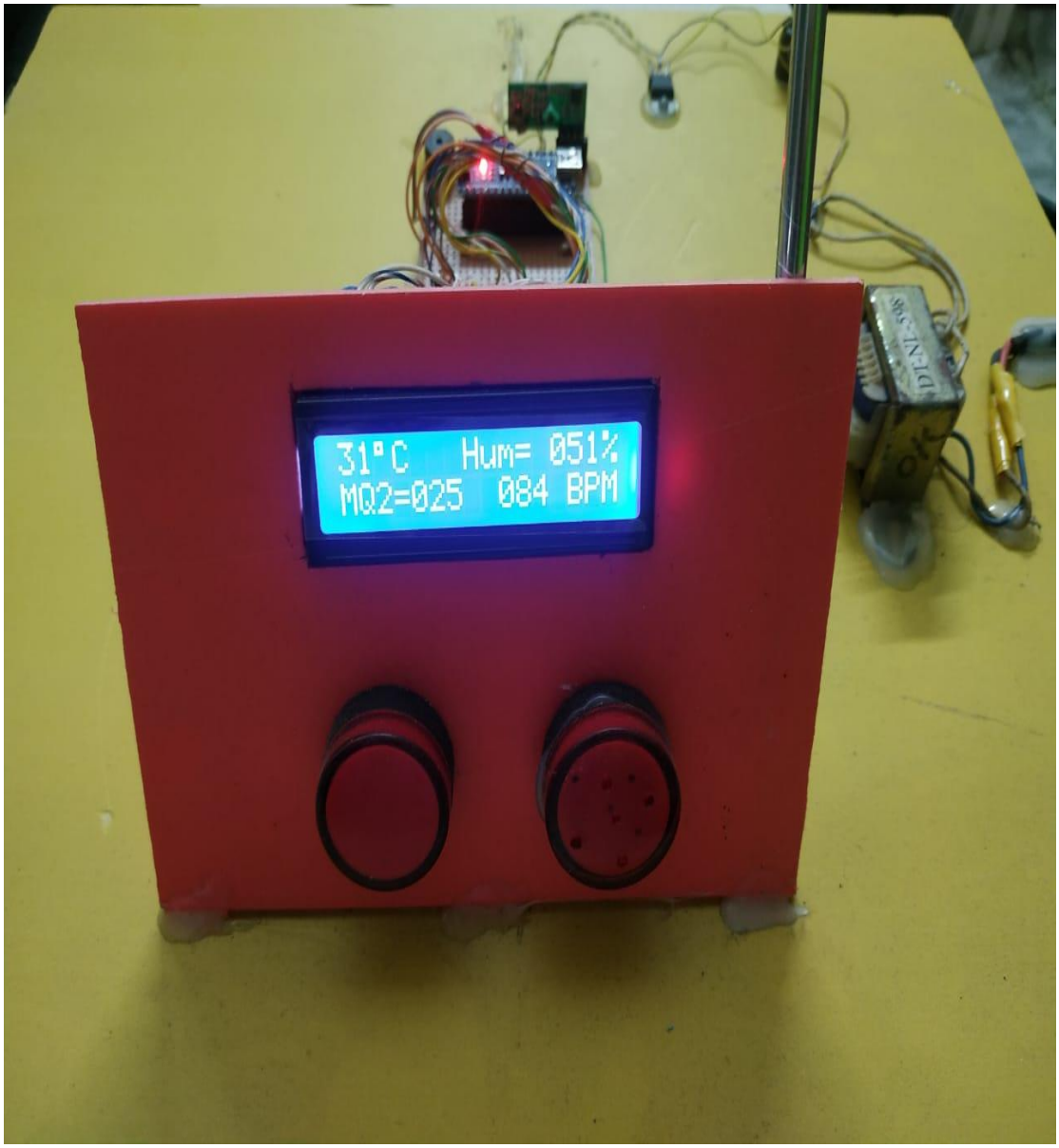

Fig. 5.3.3 : Output in LCD screen

To test our sensor's sensitivity we increase the concentration of toxic gas in our gas sensor. **Fig. 5.3.4** shows the result in LCD screen after the presence of toxic gas. We see the density of gas increased (208 PPM).

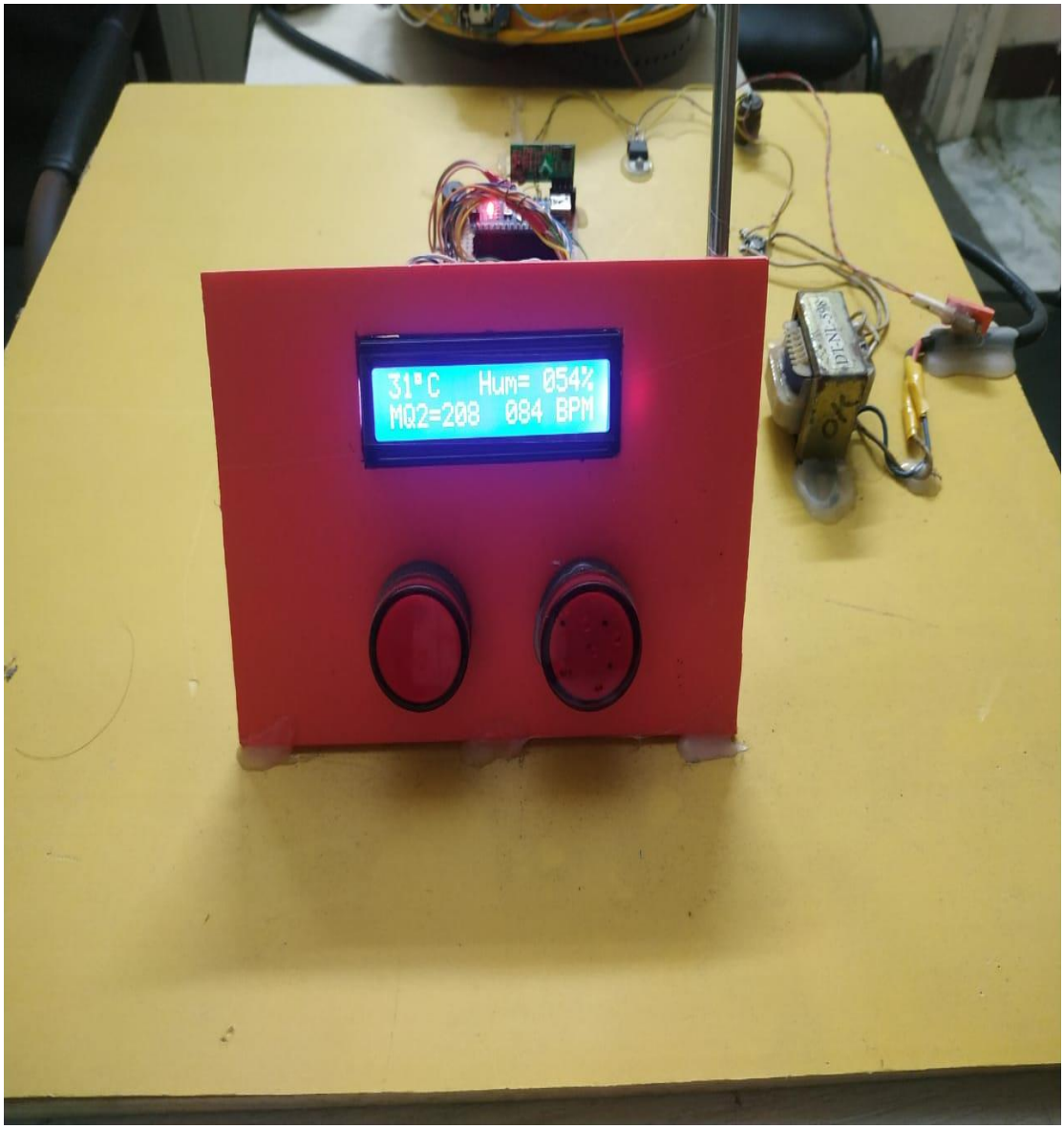

Fig. 5.3.4 : Output in LCD screen after increasing concentration of gas

Fig. 5.3.5 shows the GSM module connected at the left side of the jacket. There is an emergency button attached with the jacket to send messages to mobile in case of emergency situation. When the button is pressed, Arduino send AT command to GSM module to send message to specific numbers. **Fig. 5.3.6** shows the messages those were received in some specific mobile phone due to the press of emergency button in the jacket by the user. In the message a link of location is send to mobile by GSM. **Fig. 5.3.7** shows the location in google map when the link is browsed. ARDUINO combining with GSM module was used to send those messages.

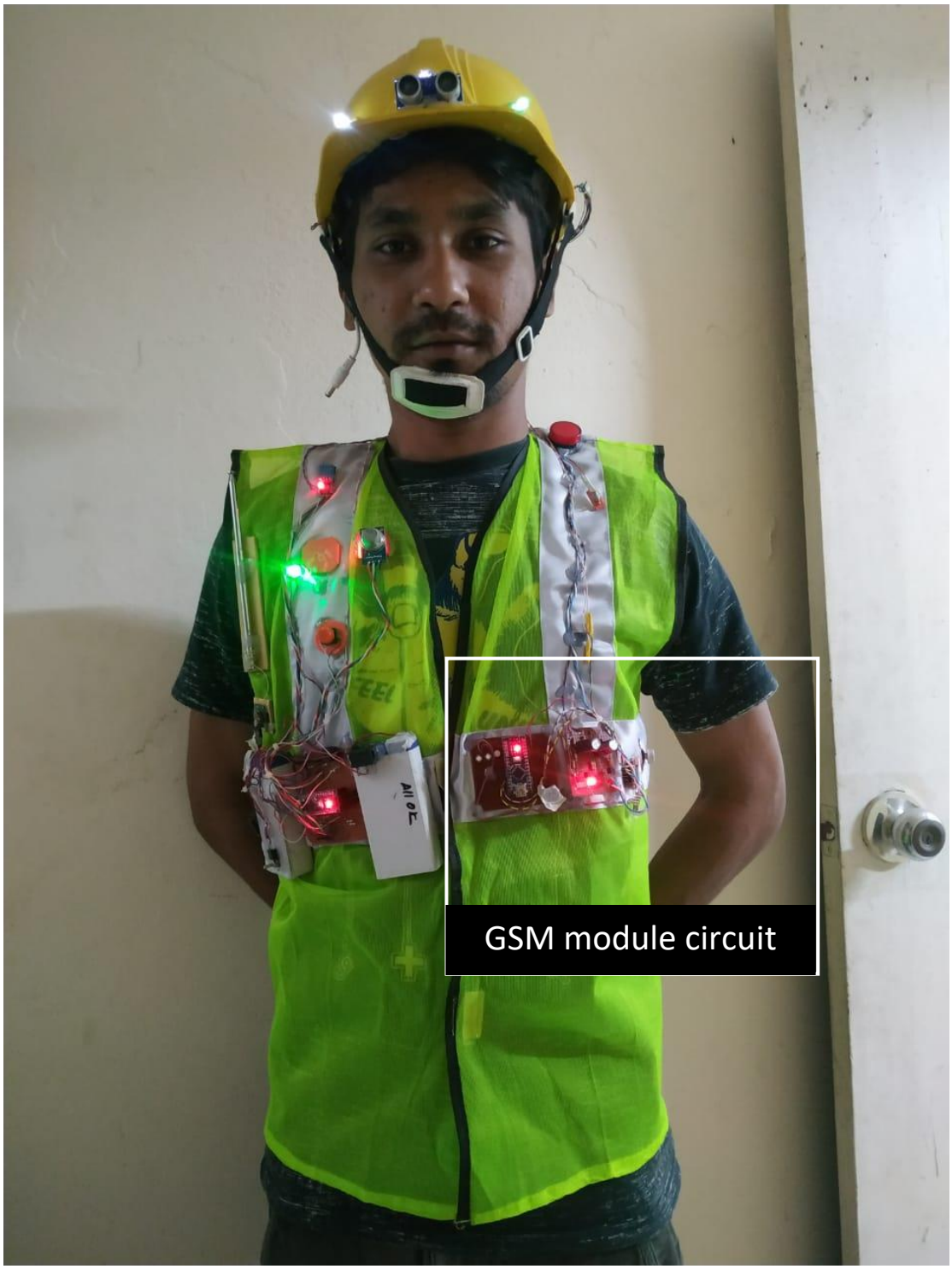

Fig. 5.3.5 : GSM module (left side)

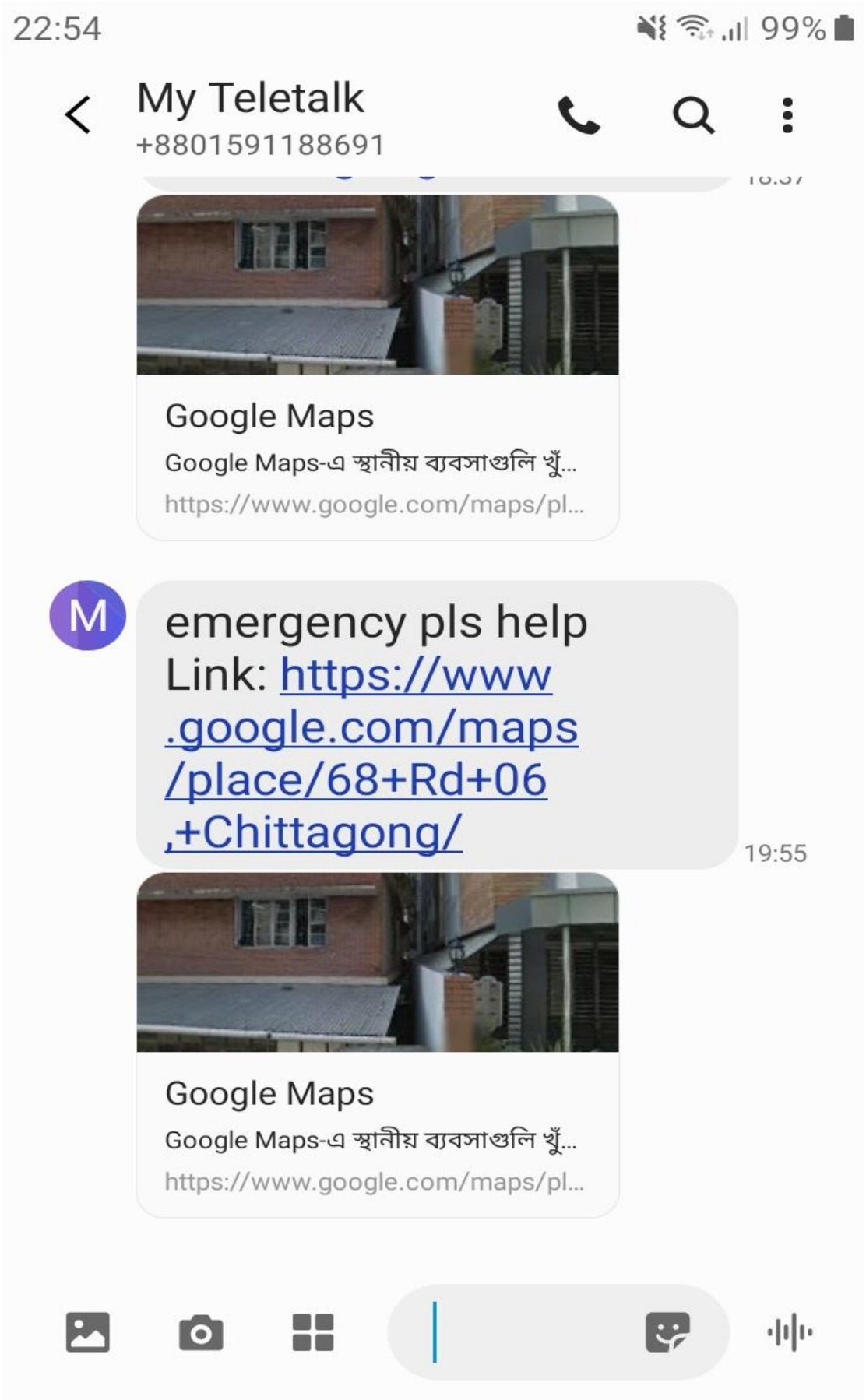

Fig. 5.3.6 : Message received in mobile from GSM module

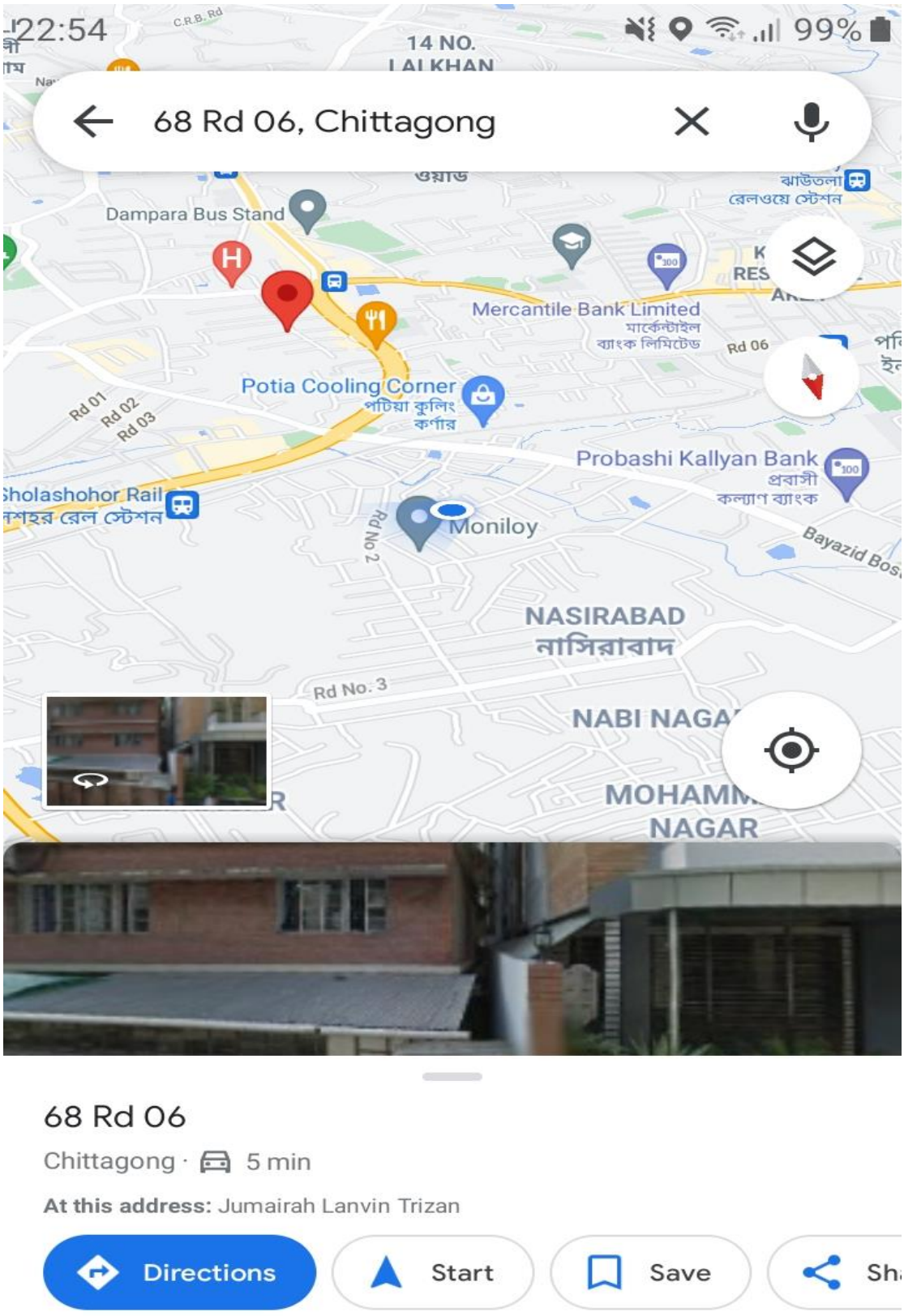

Fig. 5.3.7 : Location opened in Browser

Fig. 5.3.8 shows the LED blinking of the helmet once it starts operating. The ultrasonic sensor continuously checks the presence of any obstacle in front of it and alert the user if there is any obstacle through a shock generator connected to users skin by a wire and a buzzer by making noise.

Fig. 5.3.8 : Helmet

5.4 Cost Analysis

We aimed on building a protective gear using the technologies around us which are cheap and effective. We used a lot of electrical apparatus to build the project. Whole project cost is shown below

TABLE 5.4 : TOTAL COST

Name of equipment	Quantity	Cost (BDT)
Arduino NANO	3	750
Gas sensor (MQ2)	1	85
GSM module	1	650
Heart rate sensor(pulse sensor)	1	250
Temperature & humidity sensor (DST11)	1	70
LED	10	20
MICROCONTROLLER	1	65
Buzzer	3	30
Transistor	4	80
Resistor	100	5
Capacitor	5	50
Motor	1	50
Relay	1	25
Jacket and Helmet	2	470
Vero board	4	80
Antenna	1	80
Transmitter & Receiver	1	110
Battery	2	210
Button	5	50
Regulator	2	20
Heat absorber	1	10
Transformer	1	80
LCD display	1	160
Potentiometer	1	5
Board	1	100
Others		520
Total Cost		**4025**

Table 5.4 shows all components we used in our project. It is mainly an Arduino based project, but in helmet circuit we used Microcontroller to reduce cost. We have used cheap but effective components which restricted our total cost to **BDT 4025,** which makes it very economical as well as perfect for commercial use.

5.5 Comparative Study

Comparison is a convenient way to find out effectiveness or usefulness or application criteria of a project. Here we compared our protective gear with the three related previous works those are implemented previously.

TABLE 5.5 : COMPARATIVE STUDY

Title	Cost (BDT)	Key Feature
Protective Gear for workers	4025	Providing automatic protection by continuously assessing the surrounding environment
GSM based Power Monitoring and Controlling System using Arduino	6000	Controlling and monitoring using wireless system
Ultrasonic sensor based distance Measurement	2200	Developing automatic distance measurement system
Gas Leakage Detection System	2550	Developing automatic toxic gas detection system

Table 5.5 shows a comparative study between our project and works those have been done before related to this field. The main problem in the most works those were carried before, was the ignorance of continuous monitoring and it is executed in the protective gear we designed. The sensors we used, continuously asses data and transmit them to monitor. Again automatic alert system is established which makes our protective gear quite unique. Again, we used comparatively cheap but effective technologies which makes our project economical too.

CHAPTER 6
CONCLUSION

6.1 Introduction

The overall project's applications, limitations and scope of development for future are discussed in this chapter. This chapter covers conclusion, applications, advantages, limitations and difficulties and future development.

6.2 Conclusion

Human body is like a machine. It is affected by environment and its sudden change. We tried to monitor human health continuously through our protective gear. In adverse situation heart rate changes which is constantly monitor by heart rate sensor as well as humidity and temperature sensor ensure sustainable level of temperature and humidity through continuous goal. At the same time as everyone keep busy by themselves in their own work, so often a situation arises when there is no one near to help in case of emergency. This problem is also overcome with the help of GSM module in which the person himself can ask for help anytime in case of emergency. In all the previous works related to this matter, continuous assessment was ignored as well as there was no system of automatic alert to user. We tried to develop a project using many sensors which continuously asses the surroundings and alert the user in case of emergency. The gear is very lighter in weight which does not put any extra burden to user. We developed the project using cheap but effective components which makes our gear economical too.

6.3 Advantages

Our protective gear is unique and can be applied to a variety of sector because of its features. The unique features make it suitable to use in any uniform.

6.3.1 Features

- All the necessary safety components are assembled in one gear. So the cost and different places for different safety issues are solved.
- It is very lighter in weight which allows it to be attached in any kind of uniform without putting any burden to users.

- The most unique feature of the gear it not only analyze environment conditions but also monitor human health regularly.
- The gear is made using technologies which are cheap so it saves a lot of money.
- All the components used in the gear can easily be replaced which make it convenient for users.

6.3.2 Applications

The project mainly aimed to provide a secure working environment and automatic alert system for workers in mines and factories. But it can be used in many other ares too. The basic application of the protective gear are

- It will be very useful for mine workers.
- It has ultrasonic sensor which is convenient for the workers in automation industries.
- It can also be useful for hiking and mountaineering for tourist and professionals.
- It can be applied for pilot and crews of aeroplane.
- It has humidity and temperature sensor which will be very convenient for the workers in the middle east for adverse weather.
- It can also be applied in medical field.
- It can also be applied for military operations.

6.4 Limitations and Difficulties

The project preparation was a long process. It includes many steps such as planning, availability of apparatus, arrangement of apparatus etc. During our project we faced some difficulties such as

- The gear can only run for a few hours because of low quality battery .
- RF transmitter and receiver can only cover a few metre and therefore not eligible for long distance.
- The system depends a lot on mobile network system. So failure of mobile network system will collapse the gear data transformation system.

6.5 Future Development

It was an effort to develop a protective gear to ensure a safer and secure working environment for human. We primarily tried to develop a project which will work successfully. However it was only a demonstrative version and not eligible for commercial use. But it can always be implemented with a bit development and modifications. Such as

- The set of battery can be placed with LiPo battery which will reduce weight as well as provide more stability.
- For sending data we used RF transmitter and receiver which is not suitable for long distance. So it should be replaced with NRF technology.
- When the gear will be made for practical use, the system will be made waterproof.

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APPENDIX

Jacket circuit

```
#include "heartRate.h"
#include <VirtualWire.h>
#include <Adafruit_Sensor.h>
#include <DHT.h>
#include <DHT_U.h>

#define DHTTYPE DHT11
#define DHTPIN  7
#define butt 3
#define buzz 13

const int transmit_pin = 12;

DHT_Unified dht(DHTPIN, DHTTYPE);

byte temp, humidity;
int mq2;
char data[18]; //0,000,000,000,000 - 17
String raw;

void setup(){
  pinMode(butt, INPUT);
  pinMode(buzz, OUTPUT);
  Serial.begin(115200);
  dht.begin();

  vw_set_tx_pin(transmit_pin);
  vw_set_ptt_inverted(true);
  vw_setup(2000);

  interruptSetup();
}

void loop(){
  mq2 = analogRead(A3);
  getDHT();
  getBPM(SERIAL_OFF);


    raw = (String)"1," + intToStr(temp) + "," + intToStr(humidity) + "," +
intToStr(mq2) + ","+ intToStr(BPM) + ",";
  else
    raw = (String)"0," + intToStr(temp) + "," + intToStr(humidity) + "," +
intToStr(mq2) + ","+ intToStr(BPM) + ",";
  Serial.println(raw);
```

```
  vw_send(strcpy(data, raw.c_str()), 18);
  vw_wait_tx();

  delay(200);
}

String intToStr(int val){
  if(val < 100) return (String)"0" + val;
  else return (String)val;
}

void getDHT(){
  sensors_event_t event;
  dht.temperature().getEvent(&event);
  if (isnan(event.temperature));
  else temp = event.temperature;
  dht.humidity().getEvent(&event);
  if (isnan(event.relative_humidity));
  else humidity = event.relative_humidity;
}
```

Receiver circuit

```
#include <LiquidCrystal.h>
#include <VirtualWire.h>

#define buzz 2

const int receive_pin = 11;

LiquidCrystal lcd(3, 8, 4, 5, 6, 7);

byte loc;
byte butt, temp, humidity, mq7, bpm;

void setup() {
  Serial.begin(115200);
  lcd.begin(16, 2);
  pinMode(buzz, OUTPUT);

  vw_set_rx_pin(receive_pin);
  vw_set_ptt_inverted(true);
  vw_setup(2000);

  vw_rx_start();

  lcd.print("Hello World!");
}
```

```
void loop() {
  char buf[VW_MAX_MESSAGE_LEN];
  uint8_t buflen = VW_MAX_MESSAGE_LEN;

  if (vw_get_message(buf, &buflen)){
    String rxd = (String)buf;
    //Serial.println(rxd);

    String tmp;
    loc = rxd.indexOf(",");
    tmp = rxd.substring(0, loc);
    butt = tmp.toInt();
    rxd.remove(0, loc + 1);

    loc = rxd.indexOf(",");
    tmp = rxd.substring(0, loc);
    temp = tmp.toInt();
    rxd.remove(0, loc + 1);

    loc = rxd.indexOf(",");
    tmp = rxd.substring(0, loc);
    humidity = tmp.toInt();
    rxd.remove(0, loc + 1);

    loc = rxd.indexOf(",");
    tmp = rxd.substring(0, loc);
    mq2 = tmp.toInt();
    rxd.remove(0, loc + 1);

    loc = rxd.indexOf(",");
    tmp = rxd.substring(0, loc);
    bpm = tmp.toInt();
    rxd.remove(0, loc + 1);
    Serial.println((String)"B: " + butt + "\tT: "  + temp + "\tH: " + humidity + "\tM: " +
mq7 + "\tB: " + bpm);
  }

  if(butt == 1){
    digitalWrite(buzz, 1);
    delay(1000);
    digitalWrite(buzz, 0);
    butt = 0;
  }

  lcd.setCursor(0, 0);
  lcd.print((String) temp + (char)223 + "C   Hum= " + intToStr(humidity) + "%");
  lcd.setCursor(0, 1);
  lcd.print((String) "MQ2=" + intToStr(mq7) + "  " + intToStr(bpm) + " BPM");
}
```

```
String intToStr(int val){
  if(val < 100) return (String)"0" + val;
  else return (String)val;
}
```

GSM module circuit

```
#include <SoftwareSerial.h>

SoftwareSerial gsm(10, 11);

#define butt1 2
#define LOCATION
"\nLink:https://www.google.com/maps/place/22.3472507,91.7843568"


#define number1 "01834600061"
#define number2 "01753445588"
#define number3 "01864649694"
#define number4 "01875752347"


int count;
bool smsFlag = 0;

void setup() {
  Serial.begin(9600);
  gsm.begin(9600);

  pinMode(butt1, INPUT_PULLUP);

  GSMinit();

}

void loop() {



  if (!digitalRead(butt1)) {
    sendSMS3("emergency pls help");
    while (!digitalRead(butt1));
  }
  delay(100);
}

void GSMinit() {
  delay(5000);
  gsm.println("AT");
  response();
```

```
  gsm.println("ATE1");
  response();
  gsm.println("AT+CMGF=1");
  response();
  gsm.println("AT+CNMI=1,2,0,0,0");
  response();
}

void sendSMS3(String txt) {
  Serial.println("Sending SMS 1.");
  sendSMS(number1, (String)txt + LOCATION);
  Serial.println("Sending SMS 2.");
  sendSMS(number2, (String)txt + LOCATION);
  Serial.println("Sending SMS 3.");
  sendSMS(number3, (String)txt + LOCATION);
  Serial.println("Sending SMS 4.");
  sendSMS(number4, (String)txt + LOCATION);
  smsFlag = 1;
}

void sendSMS(String number, String txt) {
  gsm.print("AT+CMGF=1\r\n");
  response();
  gsm.print("AT+CMGS=\"");
  response();
  gsm.print(number);
  gsm.print("\"\r\n");
  response();
  gsm.print(txt);
  gsm.write(0x1A);
  gsm.print("\r\n");
  delay(3000);
  response();
}

void response() {
  while (!gsm.available());
  if (gsm.available()) {
    gsm.readString();
  }
}
```

Obstacle sensing circuit

```
;-------------------------------------------------------------------------
;**** Added by Fuse Configurator ****
; Use the Fuse Configurator plug-in to change these settings

Device = 16F73

Config FOSC_HS, WDTE_OFF, PWRTE_OFF, CP_ON, BOREN_OFF
```

```
;**** End of Fuse Configurator Settings ****
;-------------------------------------------------------------------------------
Xtal 20
Declare Hserial_Baud = 115200
Declare Hserial_RCSTA = %10010000
Declare Hserial_TXSTA = %00100100
Declare Hserial_Clear = On
All_Digital = true

Symbol motor = PORTC.3
Symbol trig = PORTC.2
Symbol echo = PORTC.1
Output motor : Output buzz
Input echo : Output trig
Clear PORTC

Dim sonar_read As Word
Dim distance As Float
Clear : Cls

main:
  GoSub check_sonar
  GoSub check_distance
GoTo main

check_sonar:
  PulsOut trig, 10, High
  sonar_read = PulsIn echo, 1
  DelayMS 10
  distance = (sonar_read * 0.028) / 2
    If distance > 2 And distance <= 8 Then
    buzz = ~buzz
    DelayMS 500
  ElseIf distance <= 2 Then
    motor = 0
    buzz = 1
  Else
    motor = 1
    buzz = 0
  EndIf
Return
```